



# Research on the Impact of Digital Technology on Enterprise Resilience under the Background of Global Industrial Chain Restructuring

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**Abstract.** Under the background of global industrial chain restructuring, the application of digital technology is key to enhancing the resilience of manufacturing enterprises. This study explores the impact of different types of digital technology applications on the resilience of China's manufacturing enterprises. Using data from 922 China A-share listed manufacturing companies in Shanghai and Shenzhen from 2011 to 2023 as samples, and taking the "chip crisis" as the baseline event, the study quantitatively analyzes corporate resilience from both long-term and short-term perspectives. Through empirical research using big data text analysis, it is found that both basic and front-end digital technology applications significantly promote both long-term and short-term corporate resilience.

**Keywords:** digital technology, corporate resilience, China manufacturing

## 1 Introduction

The current complex international landscape is accelerating the restructuring of global industrial chains toward localization, supply chain diversification, and regional specialization. How to rebuild manufacturing resilience and safeguard supply chain stability remains a critical issue requiring in-depth exploration. Existing research demonstrates that digital technology applications play an irreplaceable role in enhancing corporate resilience. Meanwhile, scholars have categorized the nine mainstream digital technologies—big data, artificial intelligence, Internet of Things (IoT), cloud computing, robotics, blockchain, 3D printing, virtual reality, and augmented reality—into two major categories: foundational and front-end<sup>[1,2]</sup>. Based on the above analysis, this paper focuses on exploring whether the two types of digital technology applications have the same effect on enhancing corporate resilience. In the process of shaping corporate resilience, can digital technology applications play a positive role in different scenarios?

## 2 Hypothesis Formulation

In management science, resilience is recognized as an essential sustainability trait for enterprises<sup>[3,4]</sup>. Long-term resilience enables businesses to transform and develop through strategic planning, capability building, technological innovation, and supply chain optimization in uncertain environments, thereby enhancing long-term competitiveness through iterative improvements after shocks. Short-term resilience refers to the immediate recovery capability required to swiftly address sudden risks and maintain core business continuity. As heterogeneous resources, digital technologies have been widely adopted by enterprises and are regarded as critical tools for risk mitigation and resilience enhancement<sup>[4]</sup>. Based on the above analysis, this study argues that digital technology applications can effectively enhance both long-term and short-term organizational resilience, leading to the following hypotheses: H1a: Base digital technology applications can improve long-term resilience; H1b: Front-end digital technology applications can improve long-term resilience; H2a: Base digital technology applications can improve short-term resilience; H2b: Front-end digital technology applications can improve short-term resilience.

## 3 Research Design

### 3.1 Sample Selection and Data Sources

This study selected 922 manufacturing enterprises listed on the China Shanghai and Shenzhen A-share markets from 2011 to 2023 as samples, and took the "chip crisis" that broke out between China and the United States in 2021 as a benchmark event to explore the impact of digital technology application on corporate resilience. To eliminate the influence of major public health events, the study excluded data from 2020 and 2022.

### 3.2 Variable Measure

**Dependent Variable.** Corporate Resilience - long term (CRL). Referring to previous studies<sup>[4,5]</sup>, this paper uses the fluctuation of return on net assets to measure the long-term toughness of enterprises, that is, the standard deviation of monthly return on net assets. Corporate Resilience - short term (CRS). Because of the strong timeliness of the impact, it is appropriate to use the changes of important indicators before and after the crisis to measure the enterprise resilience from a short-term perspective. Therefore, this paper refers to the research of previous scholars and uses the decline of roe in the process of "chip crisis" to measure the loss of enterprises<sup>[6,7]</sup>.

**Explanatory Variable.** Base digital technology applications (BDTA) and front-end digital technology applications (FDTA). Referring to the research of the previous scholars<sup>[8]</sup>, this paper takes the frequency of digital technology keywords appearing in enterprise annual reports as a proxy index to measure the application level of digital

technology. Firstly, the annual reports of listed companies of all sample enterprises are collected and sorted out; Secondly, the digital technology keyword thesaurus is constructed with full reference to the research of ZHAO<sup>[8]</sup>, and the python language programming is used to capture and count the keywords of the text content of the annual report, and the number of digital technology characteristic words appearing in the annual report is obtained. Thirdly, the digital technology feature words are classified according to the type of basic digital technology and the type of front-end digital technology. The classification method is to identify whether the feature words include technical terms such as Internet of things, big data, cloud computing, artificial intelligence, blockchain, robotics, 3D printing, augmented reality and virtual reality<sup>[1,2]</sup>. Finally, the ratio of the number of words of the two digital technologies to the total number of words in the annual report is used to construct the digital technology application index.

**Control Variable.** As shown in Table 1, to enhance the reliability of the findings, this study controls for a series of variables that may influence corporate resilience.

**Table 1.** Variable description.

Type	Symbol	Name	declaration
dependent variable	CRL	corporate resilience - long term	standard deviation of return on net assets per month
	CRS	corporate resilience - short term	difference between post-crisis return on equity and pre-crisis peak return on equity divided by pre-crisis peak return on equity
explanatory variable	BDAT	base digital technology applications	number of keywords in basic digital technology / total number of keywords in annual report
	FDAT	front-end digital technology applications	front-end digital technology keywords count/total word count in annual report
control variable	FS	firm size	ln(total assets)
	FA	firm age	ln(year of current year-year of company establishment + 1)
	BM	book-to-market ratio	book value/total market value
	LEV	debt-to-asset ratio	total liabilities at year-end / total assets at year-end
	REC	accounts receivable ratio	net accounts receivable / total assets
	RCA	capital accumulation rate	current year owner's equity / previous year owner's equity-1
	FL	financial leverage	(net profit + income tax + financial expenses) / (net profit + income tax)

SOE ownership nature the dummy variable is 1 for state-owned enterprises and 0 for non-state-owned enterprises.

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### 3.3 Model Select

To examine the direct impact of H1a and H1b—two types of digital technology applications—on corporate long-term resilience, this study constructs Panel Data Model (1):

$$CRL_{i,t} = \alpha_0 + \alpha_1 DTA_{i,t} + \alpha_2 Controls_{i,t} + \delta_i + \mu_i + \varepsilon_{i,t} \tag{1}$$

Where I is the enterprise and t is the year; DTA is two digital technology applications; Controls are control variables, including enterprise size, enterprise age, book to market ratio, asset liability ratio, financial leverage, and ownership nature;  $\alpha_0$  is intercept item;  $\alpha_1$  is the regression coefficient;  $\delta_i$  is time fixed effect,  $\mu_i$  is individual fixed effect and disturbance term  $\varepsilon_{i,t}$ .

To examine the direct impact of H2a and H2b—two digital technology applications—on corporate short-term resilience, this study constructs a cross-sectional data model (2):

$$CRS_i = \alpha_0 + \alpha_1 DTA_i + \alpha_2 Controls_i + \varepsilon_i \tag{2}$$

Where, I is the enterprise; DTA is two digital technology applications; Controls are control variables, including enterprise size, enterprise age, proportion of accounts receivable, capital accumulation rate, financial leverage and ownership nature;  $\alpha_0$  is intercept item;  $\alpha_1$  is the regression coefficient;  $\varepsilon_i$  is a disturbance term.

## 4 Empirical Analysis

### 4.1 Descriptive Statistics and Correlation Analysis

As shown in Table 2 and table 3, the descriptive statistical results of each variable are reported. In terms of enterprise resilience, the sample enterprises differ greatly in the performance of long-term and short-term resilience. In terms of digital technology application, the median of the two digital technology application indexes are less than the mean in the long-term perspective and the short-term perspective, respectively, indicating that the digital technology application of sample enterprises has obvious right deviation, and the digital technology application of some enterprises is relatively mature. In terms of control variables, the data performance and characteristics are consistent with the results of existing studies.

As shown in Table 4 and table 5, from the perspective of correlation analysis, the correlation coefficient between variables is low. In addition, the study tested the variance inflation factor (VIF) of the two groups of data, in which the maximum value of VIF was 1.700, and the VIF of all explanatory variables did not exceed the threshold

value of 10. The above tests show that the influence of multicollinearity of inter group variables on the analysis results can be excluded.

**Table 2.** Descriptive Statistics\_Long-term.

variable	observed number	mean value	standard deviation	median	minimum	maximum
<i>ORL</i>	9220	0,032	0,026	0,025	0,003	0,133
<i>BDTA</i>	9220	0,050	0,068	0,024	0,001	0,328
<i>FDTA</i>	9220	0,062	0,061	0,024	0,001	0,247
<i>FA</i>	9220	2,831	0,352	2,890	1,386	3,611
<i>FS</i>	9220	22,251	1,197	22,088	19,671	26,444
<i>LEV</i>	9220	0,394	0,188	0,388	0,032	0,902
<i>SOE</i>	9220	0,344	0,475	0,000	0,000	1,000
<i>BM</i>	9220	0,627	0,242	0,632	0,074	1,246
<i>FL</i>	9220	1,325	1,148	1,051	-1,982	11,549

**Table 3.** Descriptive Statistics\_Short-term.

variable	observed number	mean value	standard deviation	median	minimum	maximum
<i>ORS</i>	922	-2,922	34,793	0,664	-581,409	87,322
<i>BDTA</i>	922	0,077	0,102	0,046	0,000	1,296
<i>FDTA</i>	922	0,108	0,146	0,064	0,000	1,300
<i>FA</i>	922	3,125	0,206	3,135	2,565	3,611
<i>FS</i>	922	22,821	1,204	22,676	19,976	26,452
<i>RCA</i>	922	0,116	0,251	0,065	-0,594	2,045
<i>FL</i>	922	1,135	0,597	1,041	-0,624	4,822
<i>REC</i>	922	0,123	0,086	0,109	0,000	0,456
<i>SOE</i>	922	0,363	0,481	0,000	0,000	1,000

**Table 4.** Correlation Analysis\_Long-term.

variable	1	2	3	4	5	6	7	8
<i>1.ORL</i>								
<i>2.BDTA</i>	0.040**							
<i>3.FDTA</i>	0.038**	0.636**						
<i>4.FA</i>	0.049**	0.114**	0.035**					
<i>5.FS</i>	0.145**	0.051**	0.007	0.295**				
<i>6.LEV</i>	0.148**	-0.003	-0.034*	0.218**	0.543**			

7.SOE	-0.015	-0.089*	-0.098*	0.228**	0.317**	0.273**		
		**	**	*	*	*		
8.BM	-0.168*	-0.069*	-0.112*	0.071**	0.413**	0.336**	0.125**	
	**	**	**	*	*	*	*	
9.FL	-0.191*	-0.094*	-0.080*	0.018*	0.122**	0.311**	0.091**	0.154**
	**	**	**		*	*	*	*

Note: \* p <0.1, \*\* p <0.05, \*\*\* p <0.01; parentheses indicate standard error (the same applies below).

**Table 5.** Correlation Analysis\_Short-term.

variable	1	2	3	5	6	7	8	9
1.ORS								
2.BDT A	0.030** *							
3.FDT A	0.021** *	0.659** *						
4.FA	0.008	-0.049	-0.051					
5.FS	0.021	0.020	0.001	0.108** *				
6.RCA	0.173** *	-0.058* *	-0.066* *	0.002	0.205** *			
7.FL	0.016	-0.030	-0.043	0.042	0.074**	0.057*		
8.REC	-0.078* *	0.224** *	0.223** *	-0.113* **	-0.194* **	-0.050	0.122** *	
9.SOE	0.035	-0.082* *	-0.079* *	0.247** *	0.264** *	0.051	-0.033	-0.118* **

### 4.2 Regression Results

As shown in Table 6, model 1 and model 2 are the regression results of the impact of digital technology application on the long-term resilience of enterprises, and model 3 and model 4 are the regression results of the impact of digital technology application on the short-term resilience of enterprises.

Model 1 and model 2 examine the relationship between the application of two digital technologies and the long-term resilience of enterprises. The regression results show that BDTA and fdta are significantly negatively correlated with ORL. This paper uses the standard deviation of return on net assets to measure the long-term toughness of enterprises. The smaller the value, the stronger the toughness of enterprises. Therefore, the regression results of model 1 show that the application index of basic digital technology is negatively correlated with the standard deviation of return on equity. The smaller the standard deviation, the smaller the fluctuation level, and the stronger the ability of enterprises to maintain system stability. The application of

basic digital technology can improve the long-term toughness of enterprises, which verifies the hypothesis H1a. Model 2 is the same as above. The regression results show that the application of front-end digital technology also has a significant positive impact on the long-term resilience of enterprises, which verifies the hypothesis H1b. The empirical test results show that both front-end and basic digital technologies can help enterprises shape and improve their long-term resilience.

**Table 6.** Hypothesis Testing Results of Digital Technology Application on Enterprise Resilience.

variable	Model 1	Model 2	Model 3	Model 4
	<i>ORL</i>	<i>ORL</i>	<i>ORS</i>	<i>ORS</i>
<i>BDTA</i>	-0.022*** (0.006)		22.259* (11.434)	
<i>FDTA</i>		-0.010** (0.005)		13.351* (8.020)
<i>_cons</i>	0.085*** (0.017)	0.087*** (0.167)	26.414 (28.570)	25.260 (28.567)
N	9220	9220	922	922
control variable	Yes	Yes	Yes	Yes
individual fixed effect	Yes	Yes	No	No
year fixed effect	Yes	Yes	No	No
<i>R</i> <sup>2</sup>	0.156	0.155	0.041	0.039
<i>F</i>	95.34	94.78	5.52	5.37

Note: the values in brackets are robust standard errors, the same as the following table

The regression results of model 3 and model 4 showed that both BDAT and FDAT had significant positive effects on ORS. This paper uses the loss of return on equity before and after the crisis to measure the short-term resilience of enterprises. The larger the value, the smaller the impact loss of enterprises, and the stronger the short-term resilience of enterprises. Therefore, the regression results of model 3 and model 4 show that both the application of basic digital technology and the application of front-end digital technology can improve the short-term toughness of enterprises, which verifies the assumptions H2a and H2b. The empirical test results show that the application of two types of digital technologies plays a positive role in maintaining the stability of earnings before and after the crisis.

### 4.3 Robustness Test

Replace the measurement methods of the explanatory variable and the explained variable in the previous article. For two types of digital technology applications, this paper uses the total word frequency of digital technology after logarithm processing to represent the application level of enterprise digital technology (BDAT\_ and FDAT\_); For enterprise resilience, select the growth rate of operating income to re-

place the standard deviation of return on net assets as the indicator to measure the long-term resilience of enterprises (*ORL*\_). The larger the value, the stronger the long-term resilience of enterprises; The loss of operating income before and after the crisis is selected to measure the enterprise's short-term resilience (*ORS*\_). The larger the value, the smaller the loss, and the stronger the enterprise's short-term resilience. As shown in Table 7, after replacing the measurement methods of explanatory variables and explained variables, the regression results are still consistent with the above conclusions, indicating that the empirical results of this paper are highly reliable.

**Table 7.** Robustness Test Results of Digital Technology Application on Enterprise Resilience.

variable	Model 1	Model 2	Model 3	Model 4
	<i>ORL</i>	<i>ORL</i>	<i>ORS</i>	<i>ORS</i>
<i>BDTA</i> _	0.006* (0.004)		2.305** (1.085)	
<i>FDTA</i> _		0.007* (0.004)		2.541** (1.092)
_cons	-1.897*** (0.187)	-1.898*** (0.187)	62.611 (27.805)	60.583 (27.725)
N	9220	9220	922	922

#### 4.4 Endogenous Test

Considering that there are differences between enterprises with higher and lower levels of digital technology application in the research sample, which will cause self selection errors in the sample, this paper uses PSM propensity score matching method to alleviate endogeneity. First, the samples were divided into high and low groups according to the median of the front-end and basic digital technology application index; Then, the control variables in the model are taken as covariates, and the nearest neighbor matching method is used to match according to one to one; Finally, after eliminating the samples that did not participate in the matching, the regression was carried out again. The regression results are shown in Table 8, still in line with the research hypothesis.

**Table 8.** Endogenous Test Results of Digital Technology Application on Enterprise Resilience.

variable	Model 1	Model 2	Model 3	Model 4
	<i>ORL</i>	<i>ORL</i>	<i>ORS</i>	<i>ORS</i>
<i>BDTA</i> _	-0.021*** (0.007)		46.016** (20.472)	
<i>FDTA</i> _		-0.009* (0.005)		29.771** (14.150)
_cons	0.087*** (0.019)	0.089*** (0.018)	18.293 (51.000)	15.958 (51.080)
N	4610	4610	455	455

## 5 Conclusion

Based on the panel data of manufacturing enterprises listed in Shanghai and Shenzhen from 2011 to 2023, this paper empirically tests the impact of two types of digital technology applications on the long-term and short-term resilience of enterprises. The results show that: 1) from a long-term perspective, the two types of digital technology applications have a significant positive impact on the long-term resilience of enterprises; 2) Taking the "chip crisis" as the base period event, the two types of digital technology applications have a significant positive impact on the short-term resilience of enterprises. Based on this, the study proposes that enterprises should advance both foundational digital technologies and front-end digital technologies simultaneously. Specifically, foundational digital technologies should be leveraged to establish robust data infrastructure, platforms, and security systems, while front-end digital technologies are employed to enhance business responsiveness and customer service efficiency. This dual-strategy approach not only strengthens short-term operational risk resilience but also boosts long-term sustainable development resilience.

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